



Approved for public release; distribution is unlimited.

JDL - Data Fusion Group

VISIONEERING - **Applications to Human Issues in Data Fusion**

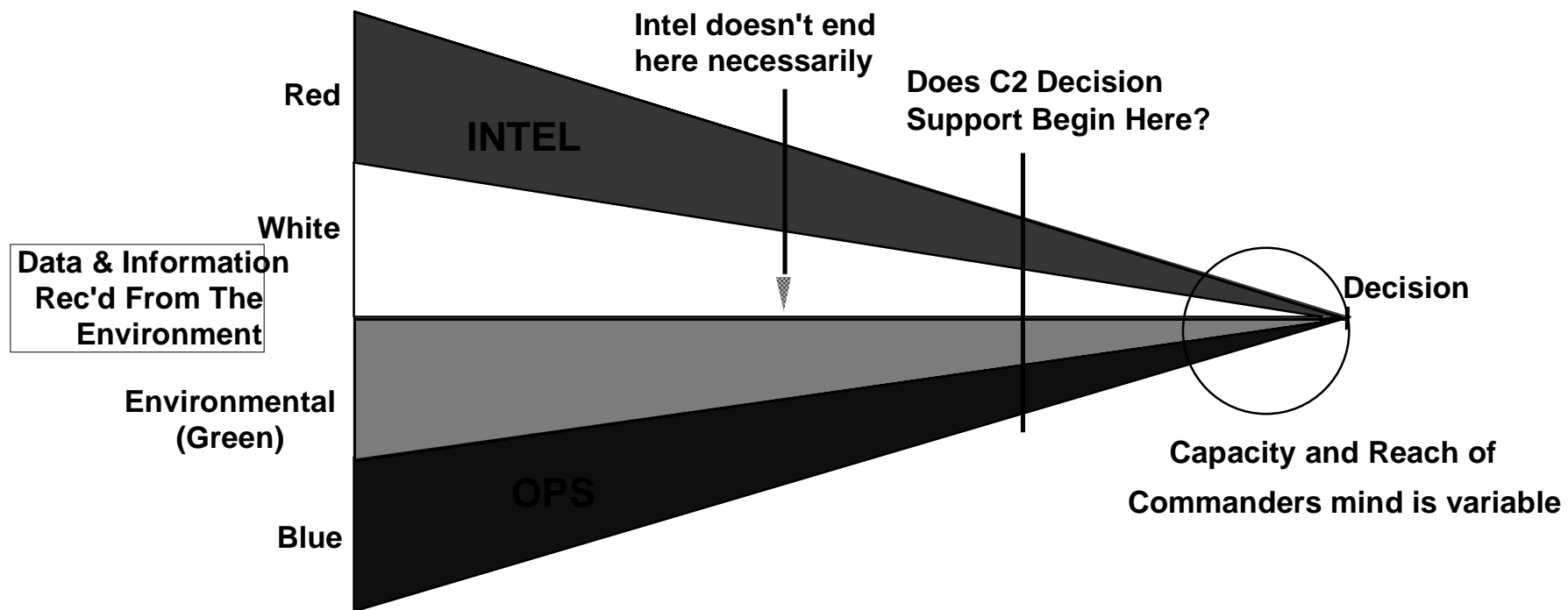
2 April 1998

Franklin E. White Jr.
NRaD Code D10T
Chair, JDL Data Fusion Group
619-553-4036
whitefe@nosc.mil

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) 02-04-1998		2. REPORT TYPE Conference Proceedings		3. DATES COVERED (FROM - TO) xx-xx-1998 to xx-xx-1998	
4. TITLE AND SUBTITLE Visioneering-Applications to Human Issues in Data Fusion Unclassified				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) White, Jr., Franklin E. ;				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME AND ADDRESS SPAWAR XXXXX, XXXXXXX				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME AND ADDRESS Director, CECOM RDEC Night Vision and Electronic Sensors Directorate, Security Team 10221 Burbeck Road Ft. Belvoir, VA22060-5806				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT APUBLIC RELEASE					
13. SUPPLEMENTARY NOTES See Also ADM201041, 1998 IRIS Proceedings on CD-ROM.					
14. ABSTRACT Data Fusion: Transforms Data into Information and Knowledge.					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:		17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19. NAME OF RESPONSIBLE PERSON	
		Public Release	17	Fenster, Lynn lfenster@dtic.mil	
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified		19b. TELEPHONE NUMBER International Area Code Area Code Telephone Number 703767-9007 DSN 427-9007	
				Standard Form 298 (Rev. 8-98) Prescribed by ANSI Std Z39.18	

Data Fusion: Transforms Data into Information and Knowledge

*The Key is Seamless FLOW to the Commander - A Person
Our "Boxes" can become artificial restrictions to the Flow*



FW-600a

Data → Information → Knowledge → Understanding

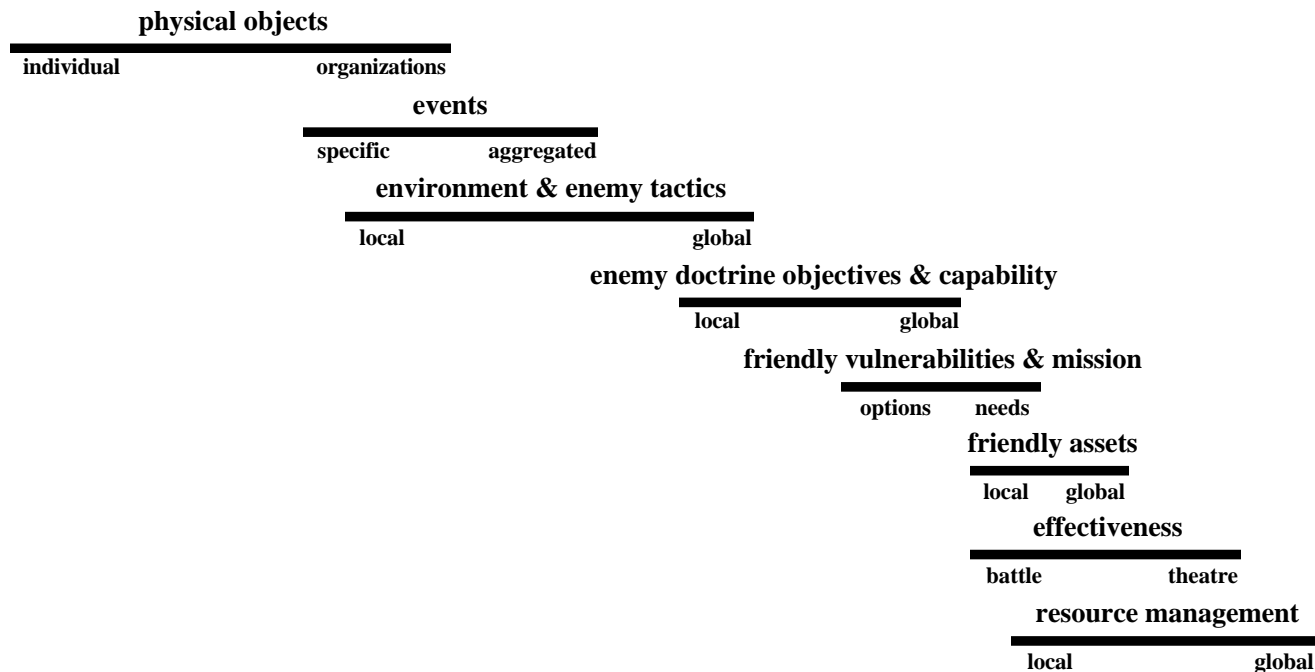
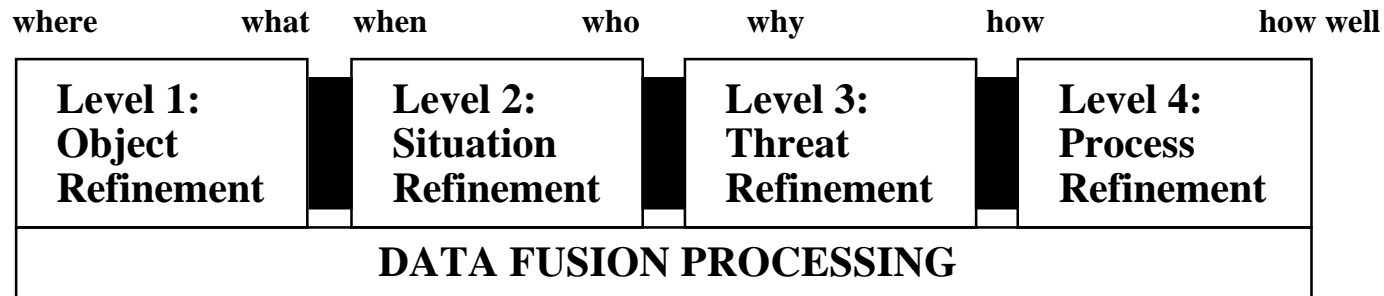
Fusion Success Requirements

To develop a successful Fusion process (automated or manual) a good understanding of the following is required:

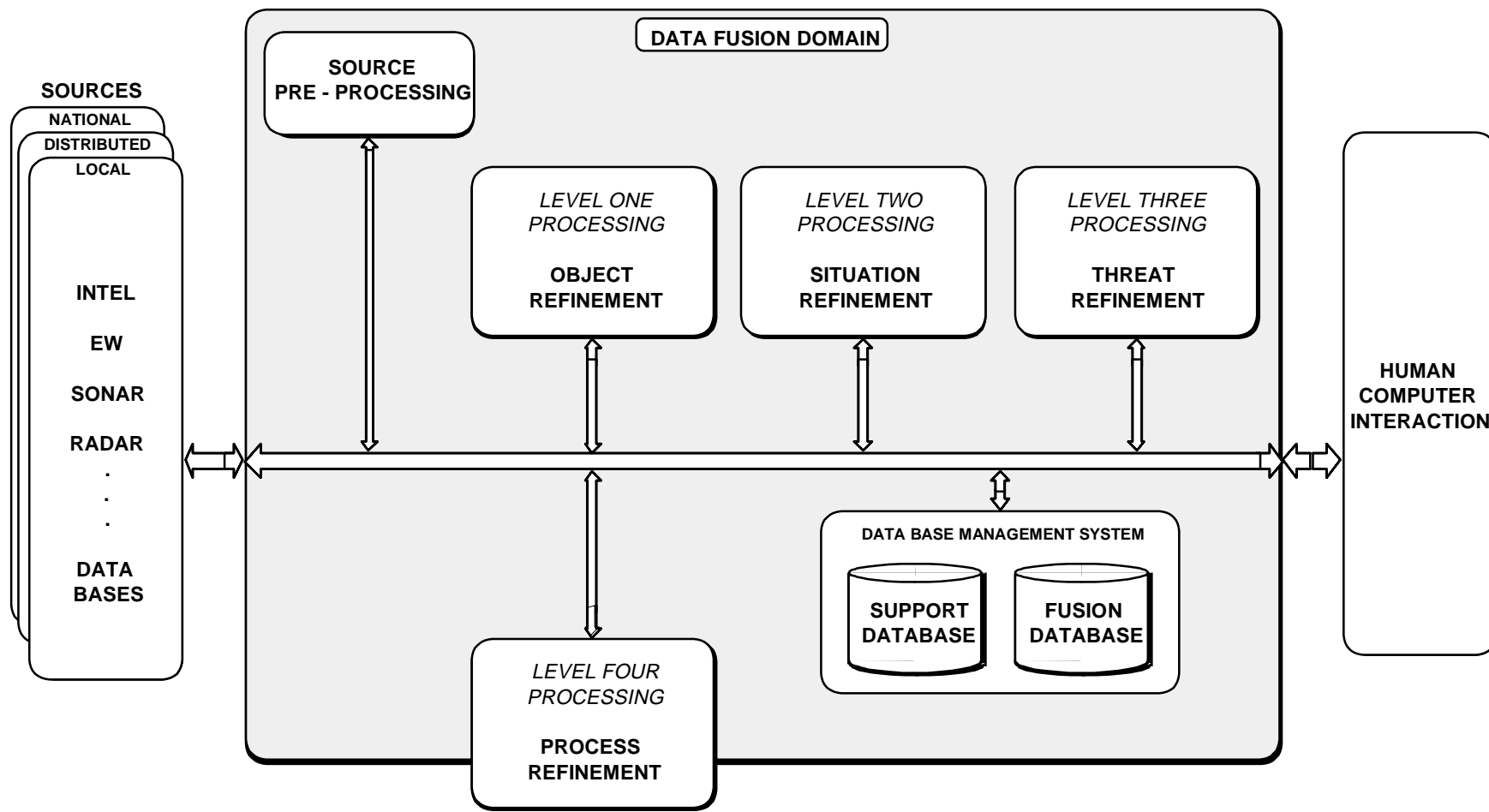
- 1. Physics of the Sensor/Collector AND the Phenomena**
- 2. Data Fusion Processes**
- 3. Warfare Mission Area**
- 4. Customer/User**

Acknowledgment: Capt W. Walls

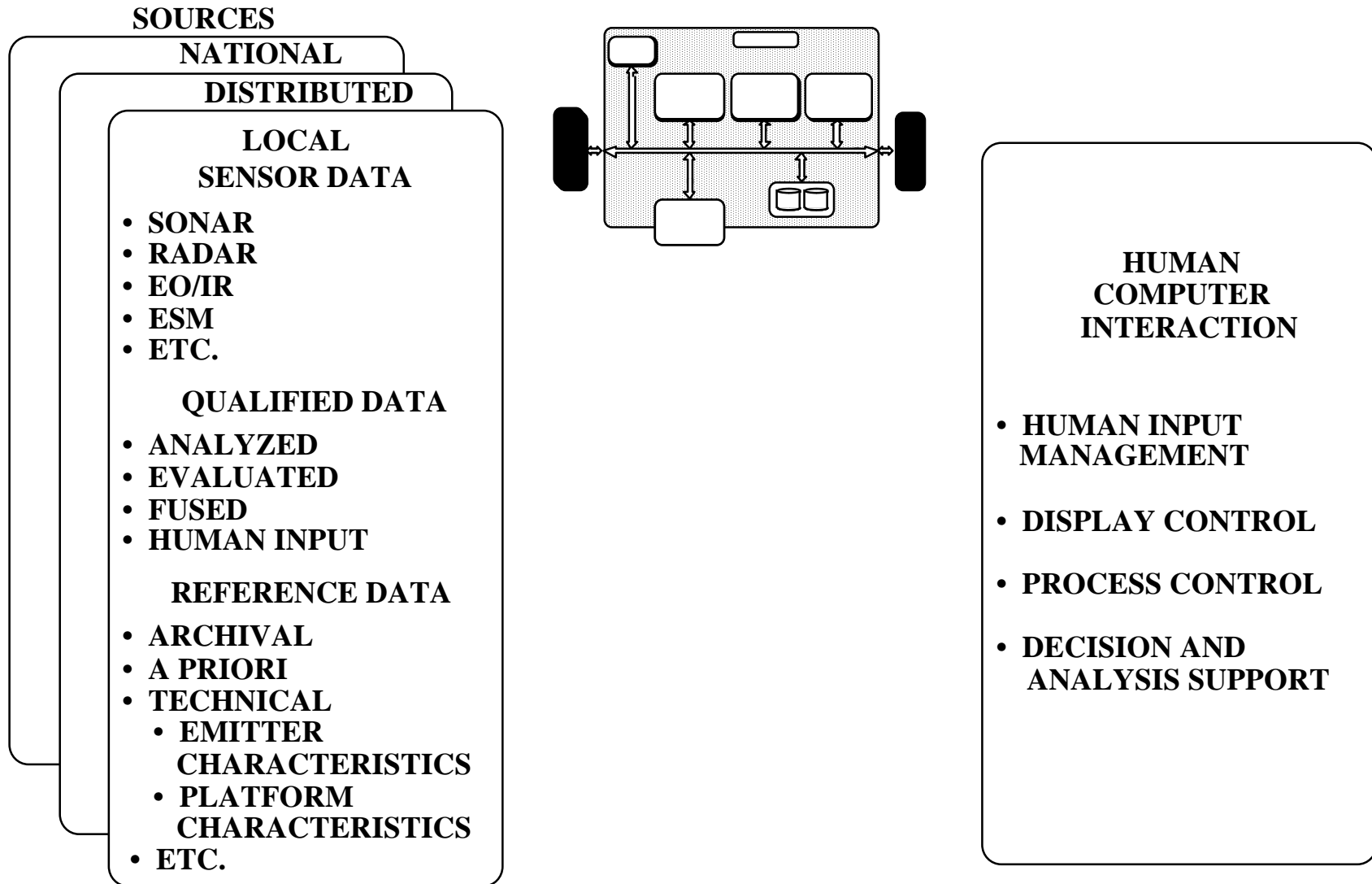
DATA FUSION: MULTILEVEL INFERENCE



DATA FUSION PROCESS



ROLE OF DATA FUSION



The “ Human Problem”

- **In Visioneering the CCOF Fusion and Broader Analysis Functions Are Transparent**
 - ◆ The dependence of the overall C² and execution processes on fusion and analysis is not evident
 - ◆ Their importance is minimized
- **Conceptually and Technically**

Operations - Technical Boundary Issue



Fusion as a Factor in “Real Life” Decisionmaking

- **Real Life = High Stakes, organizations, action-feedback, training**
- **Emphasis on Descriptive vice rational or prescriptive**
 - ◆ **Meta-cognition - strategy selection**
 - ◆ **Sequential vice comparative/analytical decisions**
 - ◆ **Satisficing & the role of heuristics**
 - ◆ **Stress effects**
- **Humans Use 2 Key Strategies**
 - ◆ **Recognition Primed Decisionmaking(RBD)**
 - ◆ **Explanation Based Reasoning (EBR)**

Recognition Primed Decision Strategy

(Klein et al)

- **Focus on situation assessment vice response**
- **First option considered is usually workable**
- **Serial vice comparative, generation of options**
- **Satisficing not optimal**
- **Reliance on mental simulation not analysis**
- **Progressive deepening of selected option**
- **Creates expectancies**

Explanation Based Reasoning Strategy

(Pennington and Hastie)

- **Construct stories (causal models) to explain events and event relationships**
- **Decisionmakers reason about the evidence**
- **Evaluate possible explanations for**
 - ◆ Consistency
 - ◆ Completeness
 - ◆ Plausibility
- **Make explicit assumptions that must be accepted**

Boundary Issue

- **Data Fusion Requirements - Derived**
- **Systems Development and Evaluation (Particularly at Higher DF Levels) Needs to be Derived from Measures of Merit of Importance at the Operator Level**
 - ◆ Specifically, “*What Matters in Making a Decision*”

I.E. *Operators MUST Work With the Technical Fusion People During the Fusion Requirements Phase AND the Measure of Effectiveness Phase*



“Trust” Within the Process

**Fusion Can’t Be Done Perfectly - So We Must
Address “Satisfactory” Levels of Quality in a
Context of Decision Support to an Operator in
a Mission Environment**

**The Test and Evaluation Issue Goes to the Heart of Trust
in the Data Fusion Process and Trust in the Automation of
the Process. The Decision Maker Must *Understand* and
Believe the Process and the Product**

**In Today's Information Environment Wrestling with this
Issue is a Important**

Stress and The Fusion Process

■ Stress (High Arousal) Causes

- ◆ Work Pressure
- ◆ Performance Pressure
- ◆ Environmental pressure

■ Effects Observed

- ◆ Hyper-vigilance (impulsiveness)
- ◆ Intolerance for ambiguity
- ◆ Tunnel Vision
- ◆ Forgetting Secondary tasks
- ◆ Reduced communication
- ◆ Short-term memory degradation
- ◆ Conceptual Rigidity

The Human Factor in the Data Fusion Process

- **Fusion Is a Fundamental Human Process in Decision Making**
- **As a Community We Must Understand Decisionmaking in Making Better Fusion Tools**
- **Need to Know More About**
 - ◆ **Strategies**
 - ◆ **Biases**
 - ◆ **Stress**
 - ◆ **Culture**
- **Need Better Models**
- **Need Measures of Merit (MOPs, MOEs, MOFEs)**

Why Is This Knowledge Important to Our Understanding

- **Bounded Rationality (Simon)**
- **Hueristics and Biases (Kahneman and Tversky)**
 - ◆ **Framing**
 - ◆ **Availability**
 - ◆ **Anchoring**
 - ◆ **Confirmation**
 - ◆ **Order Effects Primacy/Recency**
 - ◆ **Representativeness**

Bias Examples

■ Primacy/Recency

◆ Hypotheses Formed Early May Lead to a Confirmation Bias

- Information/Product which confirms the initial hypothesis is sought out
- Confirming evidence is considered more conclusive than dis-confirming evidence

◆ Hypotheses Formed Late May Result in an Availability Bias

■ Framing

◆ Significant Shifts in Preference Occur When an Outcome Is Framed As a Loss Rather Than a Gain

How Fusion Process Automation Interfaces to This Decision Process Can Be a Major Factor in Its Success or Failure

Approach

- **Set Standards for Trust**
- **Invest in Decision Research and Fusion Interaction**
- **Establish Categorization and Classification of Failure Modes**
- **Involve the Operator - Operators Must Take A Stand**
 - ◆ **What Level of Failure is Acceptable**
 - ◆ **What Problems are Really Critical**
 - ◆ **What Error Budget can be Accepted**
 - ◆ **How Can Fusion Best Impact Their Decision Process**